F. SUMMARY AND FUTURE PERSPECTIVE

Global Energy Needs and U.S. Technological Leadership

Even if new nuclear plants will not be needed in the U.S. for 5-10 years, the U.S. can still benefit today from a strong nuclear R&D program, and from sales of U.S. nuclear technology and services overseas. Jobs will be created in the U.S., global energy security and nuclear safety will be enhanced, U.S. leadership in nuclear policy matters will be strengthened, and global environmental quality will be improved. Sales of U.S. nuclear technology and services overseas help retain U.S. expertise and infrastructure during a period of slow growth in demand for new plant construction in the U.S. In the U.S., nuclear R&D will enhance the option to increase the operating life of current plants and thus result in lower energy costs to consumers from nuclear plants that will have already been paid for, and for which fuel supplies will be secure, stable, and inexpensive.

Maintaining a modest but respected nuclear energy research program is an essential element of this nation's overall ability to lead the world in nuclear policy matters -- matters for which we have a vital national interest. The concept at the core of the Treaty on the Non Proliferation of Nuclear Weapons (NPT) is that the U.S. and other nuclear-capable nations will support developing nations in their efforts to develop peaceful-use nuclear technologies, in return for their commitment not to develop nuclear weapons. For this quid pro quo to function effectively, the U.S. must maintain a strong and globally competitive posture in peaceful use technologies, particularly commercial nuclear energy technologies that are proliferation resistant. Fulfilling the mandate for U.S. nuclear energy research contained in the Atomic Energy Act is essential to accomplishing this peaceful-use mission.

U.S. leadership in peaceful uses of nuclear technology (e.g., energy, medical, industrial) enhances safety and non-proliferation by assuring U.S. influence in establishing international nuclear safety and non-proliferation standards and processes. U.S. leadership in nuclear R&D contributes to global respect for America's long term commitment to nuclear matters that are vital to our national interest. A strong R&D investment is a clear indication that the U.S. will remain a trusted leader and supplier of safe and reliable nuclear technology for many decades.

Unfortunately, the U.S. has lost its lead in several nuclear energy technology areas, notably, test facility capability, nuclear plant fabrication and construction, nuclear fuel cycle, radioactive waste management, and overall nuclear energy R&D infrastructure capability, including national laboratory, private sector, and university program capabilities. The 1995 National Critical Technologies Report[14] issued by the Administration's Office of Science and Technology Policy concluded that "*... the United States is likely to fall behind in next-generation reactors because of large funding cuts for reactor R&D.*" In the area of advanced designs, particularly evolutionary

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[14] 1995 National Critical Technologies Report; U.S. Office of Science and Technology Policy (OSTP), 1995

ALWRs, overseas competition to U.S. suppliers is stiff. French and Japanese design, fabrication, and construction capabilities clearly rival, or surpass U.S. capability. Japan alone spends over $3 billion per year on government-sponsored nuclear energy R&D, 100 times more than the amount DOE proposed to invest in FY98.

From a position of technology leadership, the United States can maintain influence over many related national goals important to the nation, such as safety of former Soviet Union reactors, non-proliferation of nuclear weapons materials, dispositioning excess nuclear weapons materials, and global warming prevention. Visible U.S. government support of nuclear R&D is an important measure of the long-term U.S. commitment to stability of supply, which the international markets, requires.

Free trade in safe and non-proliferating peaceful-use technologies is important to U.S. economic interests and U.S. strategic positions in nuclear policy matters. The inability to offer U.S. nuclear power technologies on the commercial market creates the opportunity for trade in less safe designs and less proliferation-resistant technologies, undermining the Non-Proliferation Treaty. Therefore, leadership in nuclear R&D not only strengthens the U.S. position in the world economy for peaceful applications of nuclear technology, but is also key to controlling the threat of expanding the availability of nuclear technologies that could be used for producing weapons materials.

U.S. leadership can be re-gained by a stronger R&D program that builds on U.S. strengths. R&D in support of the ALWR, LWR license renewal, and LWR safety, reliability, and economic improvement are the most important factors in retaining or re-establishing U.S. nuclear technology leadership. The comprehensive, integrated capability of the U.S. nuclear energy program is another strength on which to build. The combined capability of the U.S. nuclear industry, the DOE, and the Nuclear Regulatory Commission (NRC) has earned respect around the world for its balanced approach to safety, the environment, weapons non-proliferation, and energy production. As a result, there is international support of U.S. designs. Such support can be enhanced by a stronger R&D program, and can result in overseas sales of U.S. technologies which support U.S. non-proliferation goals, and which create high-quality jobs domestically, with an accompanying improvement in the U.S. balance of trade.

The Long Term Need for Nuclear Energy

Long term demographics and energy projections consistently show a large increase in global energy demand over the next few decades. This energy is needed to satisfy the needs of an increasing world population striving for a higher level of quality of life that is still only a fraction of that enjoyed in the U.S. today. The United Nations projects a global population of more than ten billion, and a population doubling time approaching only fifty years, by the middle of the next century. Predictions for annual global energy demand are for about 15 times today's level within 200 years, and an increase of more than 2.5 times current global energy demand by 2060. Even assuming optimistic contributions from fossil fuels, renewables, and increased efficiency and conservation, nuclear power will be counted on to help meet this need.

Even with aggressive expansion of renewable energy and a 50% reduction of global energy demand through efficiency improvements, very large amounts of non-fossil, non-intermittent baseload capacity will be needed in the next 200 years. The notion that energy efficiency alone can stabilize global energy demand at present levels is not justified based on realistic data, unless most of the world's population is condemned to perpetual poverty. Long term planning must address a range of credible and socially acceptable scenarios, and recognize that the only technology in large use today that can confidently address these long-term trends in an environmentally acceptable way is nuclear energy.

In the U.S., economic stability and quality of life would be adversely affected without the option to utilize nuclear power plants to meet the present and future needs for environmentally clean and economically competitive electric power, as well as commitments to reduced greenhouse gas emissions. Nuclear energy is also critical to U.S. energy security, which is an important underpinning to maintaining overall national security. It is an essential part of our diverse mix of fuel and technology options for power generation. Nuclear power plants shield the nation from the debilitating effects of fossil fuel supply instabilities and price shocks, and have proven to be among the most reliable of energy sources, immune to many weather and natural disaster-related challenges to our nation's power generation system.

As planners and policy makers look to the energy needs of the next 2-3 decades, it is clear that significant new baseload capacity will need to be installed to meet new demand and replace existing capacity that has reached the end of its useful life. Tough decisions will need to be made, balancing the expectations of many that fossil fuels will continue to dominate new capacity for cost reasons, and the expectations of others that renewable energy will dominate, in order to avoid the environmental impacts of fossil fuels. If the environmental concerns for fossil fuels grow, but the cost, reliability, and capacity objectives associated with renewables are not achieved, then nuclear energy must be recognized as the optimum choice -- safe, reliable, economically competitive, and pollution-free.

The Option to Build New Nuclear Energy Plants

This picture of safe, reliable, clean and affordable electricity from nuclear energy, combined with positive trends in current U.S. nuclear energy plant performance and the performance of U.S.-designed plants overseas, should be considered by national policy makers, as they seek viable alternatives to increased use of fossil fuels -- ones that can handle potentially major increases in the nation's baseload capacity without the imposition of burdensome carbon taxes. Given the uncertainties in the availability and economics of other alternatives, policy makers should seriously consider strategies that ensure the nuclear option would be available in the U.S. as the need arises.

Fortunately, a major part of this task -- that part related to defining the technical characteristics of future Light Water Reactors (LWRs), and completing engineering work necessary to ensuring the availability of the option to build new nuclear plants -- is essentially complete. DOE, working with the electric utilities through EPRI, has cost-shared the development of the next generation of Advanced Light Water Reactors (ALWRs) for almost a decade. These advanced designs are based on utility (user) requirements that have been approved by NRC. They

incorporate major improvements in safety, reliability, and economics over prior designs. Both evolutionary ALWR designs (the ABWR and the System 80+) received design certification from the Nuclear Regulatory Commission (NRC) in 1997, supporting the option for utilities to order and construct evolutionary ALWRs, as baseload electricity needs increase. The final ALWR design, the passively safe AP600, was certified by NRC in 1999.

The lack of a near-term need for large baseload capacity additions in the U.S., combined with the uncertainty of electricity sector deregulation, have allowed utilities to postpone consideration of new large baseload plants (either nuclear or coal). Utilities have faced unresolved institutional barriers to nuclear energy that have prevented them from considering new nuclear capacity. That picture may be changing, as reserve margins decrease and the barriers to new baseload plant construction begin to subside. New capacity additions, where needed, are currently being handled by smaller, easy-to-construct combined cycle natural gas generating plants, which currently enjoy lower fuel costs but contribute to greenhouse gas emissions. However, low gas prices are not assured into the next century, and the environmental benefits of nuclear energy are becoming increasingly attractive. On balance, industry planners expect that orders for new nuclear plants could resume in the U.S. sometime in the next decade. Most utilities favor keeping the nuclear option open for future needs; and national policy leaders and energy planners concerned with environmental effects of fossil fuels are increasingly suggesting nuclear energy be considered an option for generation of combustion-free electricity.

For future nuclear energy, the largest cost uncertainties are driven as much or more by institutional factors than technical factors. This is why the industry initiated a comprehensive strategic planning process in 1990 for the ALWR that addressed both technical and institutional elements. However, some of the regulatory uncertainties can be stabilized through nuclear R&D, and many opportunities are presented in this Joint Strategic Plan for substantial cost reductions through new technology, despite the institutional barriers.

Summary

Funding projections over the next five years for nuclear fission energy supply R&D are difficult to forecast, given large uncertainties in both industry and federal R&D budgets. Expectations are that Congress will eventually conform to the PCAST recommendations for nuclear energy R&D.

Maintaining a strong nuclear energy R&D program is important to U.S. domestic interests to sustain a diverse mix of energy supply options with a safe and economic nuclear component. Nuclear energy R&D is essential to improving current plant performance so that it can remain competitive with alternative sources, and to providing the option for utilities to select nuclear generation for new baseload capacity, when needed. The R&D proposed here should lead to results that will improve the safety, performance, and cost-effectiveness of nuclear energy, and expand global markets for U.S. technology.

This is a critical time in the shaping of policies that will impact the future use of nuclear energy in the U.S. The Department and EPRI will work together to assure that the U.S. nuclear energy R&D program supports the national interest. This Joint Strategic Plan for nuclear energy R&D provides a venue for increasing the coordination on our mutual R&D goals.